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## REMARKS

### *Claim Rejections - 35 USC §102*

**Claims 1-5, 19, and 20 are rejected under 35 USC §102(a) as being anticipated by Liao (USPN 6,114,238, hereinafter "Liao"), newly applied.**

Pertaining to independent claims 1 and 19, Applicants respectfully traverse the rejections since the Applicants' claimed combination, as exemplified in claim 1, includes the limitations not disclosed in Liao of:

"a conductive material recessed in said first barrier layer in said channel opening to form a recessed channel; and  
a second barrier layer disposed in said first barrier layer and over said conductive layer, said second barrier layer of a barrier material."  
[underlining and italics for clarity]

It is respectfully submitted that Liao FIGs. 2C and 2D do not show the invention disclosed by Liao and Liao FIG. 2D is incorrect in showing the second metal layer 212a within the first barrier layer 206. It is believed that it would be obvious to one having ordinary skill in the art that Liao FIG. 2D should show the second metal layer 212a above the first barrier layer 206.

Starting with Liao FIG. 2B and going to Liao FIG. 2C, Liao col. 2, lines 45-47, discloses the removal of the layer 202a:

"Referring to FIG. 2C, the nitrogen oxide layer 202a on the dielectric layer surface 202 is removed selectively by wet or dry etching." [underlining for clarity]

Referring back to FIG. 2B, it is evident that the above step of removing the layer 202a will leave the first barrier layer 206 and the metal layer 208a containing nitrogen raised above the surface of the dielectric layer 202. The indentation (or a recess) shown in FIG. 2C could not exist. Further, the Liao disclosure does not mention an indentation.

The disclosure of Liao FIG. 2C continues by describing deposition of the second metal layer 212, with no disclosure or teaching of how it would be possible for any indentation to occur in Liao FIG. 2C, in Liao col. 2, lines 47-48:

"A second metal layer 212 is formed on the substrate 200 by sputtering."

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The disclosure of Liao then continues to disclose the formation of the barrier layer 212 in Liao col. 2, lines 48-58:

"A high temperature process such as annealing makes the nitrogen in the nitrogen-containing metal layer 208a and the second metal layer 212 react. A metal nitride layer 212a is formed at the interface of the metal layer containing nitrogen 208a and the second metal layer 212, as shown in FIG. 2D. The reaction temperature, such as 400°C., is controlled until the metal nitride layer 212a formed. The second metal layer 212 includes tantalum, titanium or tungsten and the second metal layer 212a includes tantalum nitride (Ta<sub>N</sub>), titanium nitride (Ti<sub>N</sub>) or tungsten nitride." [underlining for clarity]

The disclosure of Liao concludes with removing unreacted metal by wet etching, which would leave a raised barrier layer above a raised first barrier layer 206 and metal layer 208, and also above the surface of the dielectric layer 202 in Liao col. 2, lines 58-61:

"The metal layer 212, which doesn't react with nitrogen, is then removed from the surface of the dielectric layer 202 by wet etching. The structure of metallization is accomplished." [underlining for clarity]

As would be evident to those having ordinary skill in the art, the Liao disclosure does not disclose any manner in which Liao FIGs. 2C and 2D as shown may be produced and is not enabling to anticipate the claimed invention.

"Under 35 U.S.C. §102, anticipation requires that . . . the prior art reference must be enabling, thus placing the allegedly disclosed matter in the possession of the public." Akzo N.V. v. U.S. Int'l Trade Comm'n, 808 F.2d 1471, 1 USPQ 2d 1241, 1245 (Fed. Cir. 1986)(citing *In re Brown*, 329 F.2d 1006, 1011, 141 USPQ 245, 249 (C.C.P.A. 1964)

Also as stated in *In re Wilder*, 429 F.2d 447, 166 USPQ 545 (CCPA 1970), a prior art reference may not legally anticipate a claimed invention if it does not place the subject matter of the claims within the possession of the public.

Based on the above, it is respectfully submitted that the subject matter of claims 1 and 19 have not been placed within the possession of the public and are allowable under 35 USC §102(a) as not being anticipated by Liao.

Pertaining to claims 4-5 and 20, these dependent claims respectively depend from independent claim 1 and are believed to be allowable since they contain all the limitations set

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forth in the independent claim from which they depend and claim additional unobvious combinations thereof.

The Examiner states in the Final Rejection that:

"The material recited in the claims are further taught by Liao 1 (see col. 1, lines 26-27, col. 3, lines 55-56, col. 2, line 23-24)."

Applicants respectfully disagree because Liao col. 1, lines 26-27, col. 3. (believed to be a reference to col. 2 since the lines do not exist) lines 55-56, col. 2, line 23-24, do not disclose the claimed limitations but relate to barrier layer materials.

Based on the above, it is respectfully submitted that claims 1-5, 19, and 20 are allowable under 35 USC §102(a) as not being anticipated by Liao.

**Claims 7-11 and 13-18 are rejected under 35 USC §102(a) as being anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Liao (USPN 6,114,238, hereinafter "Liao").**

Pertaining to independent claims 7 and 13, Applicants respectfully traverse the rejections since the Applicants' claimed combination, as exemplified in claim 7, includes the limitations not disclosed in Liao of:

"recessing said conductive layer inside said first barrier layer to form a recessed channel; and forming a second barrier layer in said first barrier layer and over said conductive layer, said second barrier layer is a barrier material."  
[underlining and italics for clarity]

It is respectfully submitted that, as explained above for claim 1, it believed that Liao FIGs. 2C and 2D do not show the invention disclosed by Liao and Liao FIG. 2D is incorrect in showing the second metal layer 212a within the first barrier layer 206.

As would be evident to those having ordinary skill in the art, the Liao disclosure does not teach or suggest any manner in which Liao FIGs. 2C and 2D may be produced and is therefore not enabling and does not place the subject matter of the claims within the

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possession of the public. *Akzo N.V. v. U.S. Int'l Trade Comm'n*, *supra*; *In re Brown*, *supra*; *In re Wilder*, *supra*.

On the question of obviousness, in *In re Sang-Su Lee*, 277 F.3d 1338, 61 USPQ2d 1430 (Fed. Cir. 2002), the Court held that the conclusion of obviousness may not be made from common knowledge and common sense of a person of ordinary skill in the art without any specific hint or suggestion in a particular reference. Liao is the only reference cited and it is respectfully submitted that there is no specific hint, suggestion, or motivation in Liao for the any obvious modification, which would render the claimed invention obvious.

If the Examiner believes that an obvious modification of Liao would render the claimed invention obvious, this belief must be based on the Examiner's personal knowledge of which he is taking official notice since there is no such disclosure or suggestion in Liao. Applicants respectfully request an Examiner Affidavit pursuant to 37 CFR §1.104(d)(2) (2002) disclosing the Examiner's personal knowledge so it may be traversed.

Pertaining to claims 8-11 and 14-18, these dependent claims respectively depend from independent claims 7 and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim additional unobvious combinations thereof.

The Examiner states in the Final Rejection that:

"The material recited in the claims are further taught by Liao ( see col. 1, lines 26-27, col. 3, lines 55-56, col. 2, line 23-24). The steps of providing, forming, removing and depositing are deemed to be inherently taught by Liao et al."

Applicants respectfully disagree. Claims 7 and 13 are process claims and the U.S. Supreme Court has stated:

"...., a process patent can only be anticipated by a similar process."  
*Carnegie Steel Co. v. Cambria Iron Co.*, 185 U.S. 403 (1902)

Liao col. 2, lines 24-51, discloses a different process from that claimed. Liao discloses a nitrogen implant into the first metal layer where the nitrogen is migrated by

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annealing to form a second barrier layer above a first barrier layer and the first metal layer. In the present invention, the conductive layer is recessed inside the first barrier layer and the second barrier layer is formed in the first barrier layer.

With regard to inherency, as indicated in MPEP §2112:

"The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ 2d 1955, 1957 (Fed. Cir. 1993)(reversed rejection because inherency was based on what would result due to optimization of conditions, not what was necessarily present in the prior art)."

In addition, as stated in *Ex parte Levy*, infra:

"In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original) (The Board reversed the examiner's rejection because the examiner did not provide objective evidence or cogent technical reasoning to support the conclusion of inherency.).

Applicants respectfully submit that there is neither a showing that the processes are the same nor a showing that the steps are inherent in Liao. Since there are no such disclosures in Liao, such inherency must be the result of the Examiner's personal knowledge. Therefore, Applicants respectfully request an Examiner Affidavit pursuant to 37 CFR §1.104(d)(2) (2002) disclosing the Examiner's personal knowledge so it may be traversed.

Based on the above, it is respectfully submitted that claims 7-11 and 13-18 are allowable under 35 USC §102(a) as not being anticipated by or, in the alternative, are allowable under 35 U.S.C. §103(a) as unobvious over Liao.

**Claims 19 and 20 in so far as understood are rejected under 35 USC §102(a) as being anticipated by Liao (USPN 6,114,238, hereinafter "Liao").**

Pertaining to claims 19 and 20, the reasons for claim 19 not being anticipated by Liao have been discussed above for claim 1. Claim 20 depends from independent claim 19 and is believed to be allowable since it contains all the limitations set forth in the independent claim from which it depends and claims unobvious combinations thereof.

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The Examiner states in the Final Rejection:

"The claims contain method of making characteristics (i.e. self aligned) given no patentable weight in determining the patentability of the final device structure."

It is respectfully submitted that those having ordinary skill in the art recognize the term "self-aligned" to mean that a structure is positioned in a specific alignment relative to another structure (e.g., one within another) and therefore is not related to a "product by process".

Based on the above, it is respectfully submitted that claims 19 and 20 are allowable under 35 USC §102(a) as not being anticipated by Liao.

Claims 1-4 are rejected under 35 USC §102(a) as being anticipated by Besser et al. (USPN 6,172,421, hereinafter "Besser").

Pertaining to independent claim 1, Applicants respectfully traverse the rejections since the Applicants' claimed combination, as exemplified in claim 1, includes the limitations not disclosed in Besser of:

"a conductive material recessed in said first barrier layer in said channel opening to form a recessed channel; and  
a second barrier layer disposed in said first barrier layer and over said conductive layer, said second barrier layer of a barrier material."  
[underlining and italics for clarity]

To clarify the Applicants' previous arguments that Besser does not disclose the above structural limitations, regardless of whether a definition of a recess or indentation is used, both are structural configurations. It is respectfully submitted that in Besser, the protective intermetallic layer 15 is a continuation of the conductive material of the interconnect 12 as indicated in Besser col. 3, lines 24-28, and col. 4, lines 19-20:

"A conductive metal layer is then deposited on the surface of the barrier layer 11 and filling the trenches to form interconnect lines 12. The conductive layer was formerly made of aluminum or an alloy, but now it is usually made of copper." (col. 3, lines 24-28) [underlining for clarity]

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"Referring now to FIG. 4, there is shown the formed intermetallic layer 15 of CuTi<sub>2</sub> formed during annealing." (col. 4, lines 19-20) [underlining for clarity]

Therefore, Besser does not disclose the claimed conductive material recessed in said first barrier layer since the conductive material 12 is part of the Besser intermetallic layer 15 and is coplanar with the top of the barrier layer 11. Also, it is submitted that since the intermetallic layer 15 is part of the conductive material 12, it cannot be said to be over itself.

Based on the above, it is respectfully submitted that independent claim 1 is believed to be allowable under 35 USC §102(a) as not being anticipated by Besser because:

"[a]nticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, *arranged as in the claim.*" [emphasis added] Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co. (730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 220 USPQ 193 (Fed Dir. 1983)))

Pertaining to claims 3-4, these dependent claims respectively depend from independent claim 1 and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim additional unobvious combinations thereof.

The Examiner states in the Final Rejection:

"The claims contain method of making characteristics (i.e. self aligned) given no patentable weight in determining the patentability of the final device structure."

It is respectfully submitted that those having ordinary skill in the art recognize the term "self-aligned" to mean that a structure is aligned in a specific position relative to another structure (e.g., one within another) and therefore is not related to a "product by process".

Based on all of the above, it is respectfully submitted that claims 1-4 are allowable under 35 USC §102(a) as not being anticipated by Besser.

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**Claims 19 and 20 in so far as understood are rejected under 35 USC §102(a) as being anticipated by Besser et al. (USPN 6,172,421, hereinafter "Besser").**

Pertaining to claims 19 and 20, the reasons for claim 19 not being anticipated by Besser have been discussed above for claim 1. Claim 20 depends from independent claim 19 and is believed to be allowable since it contains all the limitations set forth in the independent claim from which it depends and claims unobvious combinations thereof.

Based on the above, it is respectfully submitted that claims 19 and 20 are allowable under 35 USC §102(a) as not being anticipated by Besser.

***Claim Rejections - 35 USC §103***

**Claims 6 and 12 are rejected under 35 USC §103(a) as being unpatentable over Liao (USPN 6,114,238, hereinafter "Liao").**

Pertaining to claims 6 and 12, these dependent claims respectively depend from independent claims 1 and 7, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim additional unobvious combinations thereof.

On the question of obviousness, in *In re Sang-Su Lee*, supra., the Court held that the conclusion of obviousness may not be made from common knowledge and common sense of a person of ordinary skill in the art without any specific hint or suggestion in a particular reference. Liao is the only reference cited and it is respectfully submitted that there is no specific hint, suggestion, or motivation in Liao for the any obvious modification, which would render the claimed invention obvious.

If the Examiner believes that an obvious modification of Liao would render the claimed invention obvious, this belief must be based on the Examiner's personal knowledge of which he is taking official notice since there is no such disclosure or suggestion in Liao. Applicants respectfully request an Examiner Affidavit pursuant to 37 CFR §1.104(d)(2) (2002) disclosing the Examiner's personal knowledge so it may be traversed.

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Based on the above, it is respectfully submitted that claims 6 and 12 are allowable under 35 USC §103(a) as not being obvious based on Liao.

The other references cited by the Examiner showing the prior art have been considered and are not believed to disclose, teach, or suggest, either singularly or in combination, Applicants' invention as claimed.

***Conclusion***

In view of the above, it is submitted that the claims are in condition for allowance and reconsideration of the rejections is respectfully requested. Allowance of claims 1-20 at an early date is solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including any extension of time fees, to Deposit Account No. 01-0365 and please credit any excess fees to such deposit account.

Respectfully submitted,



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